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Introduction

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

DRAFT INTERNATIONAL STANDARD

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Condensed aerosol fire extinguishing systems — Requirements and test methods for components and system design, installation and maintenance — General requirements

*Systèmes d'extinction d'incendie utilisant des aérosols — Exigences et méthodes d'essai pour la conception
des composants et des systèmes, l'installation et l'entretien — Exigences générales*

ICS: 13.220.10

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15779 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media and firefighting systems using gas*.

Introduction

Firefighting systems covered in this International Standard are designed to provide a supply of condensed aerosol extinguishing medium for the extinction of fire.

Several different methods of supplying condensed aerosol extinguishant to, and applying it at, the required point of discharge for fire extinction have been developed in recent years, and there is a need for dissemination of information on established systems and methods. This International Standard has been prepared to meet this need.

The requirements of this International Standard are made in the light of the best technical data known to the working group at the time of writing but, since a wide field is covered, it has been impracticable to consider every possible factor or circumstance that might affect implementation of the recommendations.

It has been assumed in the preparation of this International Standard that the execution of its provisions is entrusted to people appropriately qualified and experienced in the specification, design, installation, testing, approval, inspection, operation and maintenance of systems and equipment, for whose guidance it has been prepared, and who can be expected to exercise a duty of care to avoid unnecessary release of extinguishant.

It is important that the fire protection of a building or plant be considered as a whole. Condensed aerosol extinguishing systems form only a part, though an important part, of the available facilities, but it should not be assumed that their adoption necessarily removes the need to consider supplementary measures, such as the provision of portable fire extinguishers or other mobile appliances for first aid or emergency use, or to deal with special hazards.

Condensed aerosol extinguishants have for many years been a recognized effective medium for the extinction of flammable liquid fires and fires in the presence of electrical and ordinary Class A hazards, but it should not be forgotten, in the planning of comprehensive schemes, that there may be hazards for which these mediums are not suitable, or that in certain circumstances or situations there may be dangers in their use requiring special precautions.

Advice on these matters can be obtained from the appropriate manufacturer of the extinguishant and/or the extinguishing system. Information may also be sought from the appropriate fire authority, the health and safety authorities and insurers. In addition, reference should be made as necessary to other national standards and statutory regulations of the particular country.

It is essential that firefighting equipment be carefully maintained to ensure instant readiness when required.

Routine maintenance is liable to be overlooked or given insufficient attention by the owner of the system. It is, however, neglected at peril to the lives of occupants of the premises and at the risk of crippling financial loss. The importance of maintenance cannot be too highly emphasized. Installation and maintenance should only be carried out by qualified personnel.

Inspection should include an evaluation that the extinguishing system continues to provide adequate protection for the risk (protected zones as well as state of the art can change over time).

[Annex D](#) deals with the tests for determination of the extinguishing density and system performance and they are designed in such a way to allow individual installers to use his or her system and carry out all of the extinguishing tests. The tests presented in [Annex D](#) have been established to evaluate application densities suitable for the protection of Class A fires with wood crib fire tests and plastic fuel hazards such as may be encountered in information technology, telecommunications and process control facilities, as well as Class B fires with heptane pan and heptane can test fires in an enclosure of 100 m³.

Condensed aerosol fire extinguishing systems — Requirements and test methods for components and system design, installation and maintenance — General requirements

1 Scope

This International Standard specifies requirements and test methods for components and gives recommendations for the design, installation, testing, maintenance and safety of condensed aerosol firefighting systems in buildings, plants or other structures, and the characteristics of the extinguishants and types of fire for which they are a suitable extinguishing medium. It covers total flooding systems primarily related to buildings, plant and other specific applications, utilizing electrically non-conducting condensed aerosol fire extinguishants for which there are sufficient data currently available to enable validation of performance characteristics by an appropriate independent authority.

Local applications of condensed aerosol extinguishing systems are not covered by this International Standard. Any local applications require a pre-engineered and pre-designed system which has been tested and approved for a specific application by a relevant authority.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3941, *Classification of fires*

EN 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

EN 60068-2-30, *Environmental testing — Part 2-30: Tests — Test Db and guidance: Damp heat, cyclic (12 h + 12 h cycle)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

aerosol extinguishing agent

condensed aerosol

extinguishing medium consisting of finely divided solid particles, generally in the order of magnitude of microns in diameter suspended in gas generated and distributed by a combustion process of a solid aerosol-forming compound

3.2

aerosol generator

non-pressurized container which, when activated, generates a condensed aerosol extinguishing agent

Note 1 to entry: The non-pressurized container system includes the mounting bracket(s).

3.3

aggressive environment

environment including the following or as defined by the appropriate authority:

- a) exterior situations exposed to the sun, ultraviolet radiation, wind, rain, or salt spray;
- b) corrosive atmospheres;
- c) abnormally dusty or moisture-laden atmospheres;
- d) extreme temperatures;
- e) vibrations and shocks

3.4

approved

acceptable to a relevant authority

Note 1 to entry: In determining the acceptability of installations or procedures, equipment or materials, the authority may base acceptance on compliance with the appropriate standards.

3.5

authority

organization, office, or individual responsible for approving equipment, installations or procedures

3.6

automatic

performing a function without the necessity of intentional human intervention

3.7

automatic/manual switch

means of converting the system from automatic to manual actuation

3.8

3.9

thermal clearance

air distance between a condensed aerosol generator and any structure or components sensitive to the temperature developed by the generator

3.10

competent person

person, suitably trained, qualified by knowledge and practical experience and with the necessary instructions, to enable the required tests and examinations to be carried out

3.11

coolant

heat-absorbing medium or process

3.12

design density

extinguishing density of extinguishant, multiplied by the safety factor, required for system design purposes

Note 1 to entry: Extinguishing density is the actual concentration of aerosol in the test room

Note 2 to entry: The extinguishing density and the design density are expressed in grams per cubic meter, g/m³.

3.13

discharge time

time from the generator activation until the end of its discharge

Note 1 to entry: Measured in s

Note 2 to entry: The end of discharge is determined by the drop of the temperature (primary) , sound (secondary) and visual if possible.

3.14

extinguishant

condensed aerosol extinguishing agent

Note 1 to entry: see “aerosol extinguishing agent, condensed aerosol”

3.15

extinguishing density

effective minimum mass of discharged extinguishant per unit of enclosure volume required to extinguish fire involving a specific fuel under defined experimental conditions, using a specific aerosol generator type and size, excluding any safety factor

Note 1 to entry: Measured in g/m^3 .

3.16

family of condensed aerosol generators

range of generators designed with the same solid compound, the same kind of cooling device, discharge outlet, ignition device, layout and internal/external architecture (varying of mass of solid compound)

3.17

effective mass

mass of discharged extinguishant required to achieve the design density within the protected volume within the specified system discharge time

3.18

hold time

period of time during which an extinguishant is required to maintain at least the extinguishing density to maintain even distribution throughout protected volume

3.19

hot work

grinding, welding, thermal or oxygen cutting or heating and other related heat-producing or spark-producing operations

3.20

ignition device

device which is able to ignite the solid aerosol-forming compound

3.21

inspection

visual examination to give reasonable assurance that the extinguishing system is fully charged and operable and has not been activated or tampered with, and that there is no obvious physical damage or condition to prevent operation

3.22

location drawing

layout diagram of protected volume clearly indicating the as-installed location of all aerosol generators, controls, maintenance isolate switch (lock-off devices), and associated components of the systems

3.23

lock-off device

lockable manual shut-off device that prevents the electrical actuation of aerosol generators

Note 1 to entry: The lock-off device may be in the form of a lockable system isolate switch.

Note 2 to entry: The actuation of this device provides an indication of system isolation.

Note 3 to entry: The intent is to prevent the discharge of agent into the hazard area when the lock-off device is activated.

3.24

lowest observed adverse effect level

LOAEL

lowest agent density at which an adverse toxicological or physiological effect has been observed

3.25

listed

systems or components that are included in a list published by a listing organization

3.26

listing organization

internationally recognized fire protection system or components test and certification organization

3.27

maintenance

thorough check to give maximum assurance that the extinguishing system will operate as intended

Note 1 to entry: Maintenance includes a thorough examination and any necessary repair or replacement of system components.

3.28

manual

requiring intentional intervention to accomplish a function

3.29

manufacturer

entity that is responsible for the design, manufacturing, packaging and quality assurance of a device before it is placed on the market

3.30

mass median aerodynamic diameter

MMAD

particle size and distribution of any aerosol statistically, based on the weight and size of the particle, along with the geometric standard deviation

Note 1 to entry: Fifty percent of the particles by weight will be smaller than the median diameter and fifty percent of the particles will be larger (US EPA Health Effects Test Guidelines OPPTS 870.1300 Acute Inhalation Toxicity, August 1998).

3.31

monitoring

supervision of the operating integrity of an electrical, mechanical, pneumatic or hydraulic control feature of a system

3.32

no observed adverse effect level

NOAEL

highest agent density at which no adverse toxicological or physiological effect has been observed

3.33

normally occupied area

area that is occupied by persons, under normal circumstances

3.34

particulate concentration

concentration of the solid fraction of the aerosol in the protected space after system discharge at the design density

Note 1 to entry: Measured in g/m³.

Note 2 to entry: This information is necessary to assess the potential health effects of accidental exposure to the agent in occupied spaces, and the potential degree of visibility obscuration.

3.35**release**

physical discharge or emission of extinguishant as a consequence of the aerosol generator's actuation

3.36**safety factor**

multiplier of the extinguishing density to determine the aerosol design density

3.37**solid aerosol-forming compound**

mixture of oxidant, combustible component and technical admixtures producing fire extinguishing aerosol upon ignition

3.38**supplier**

entity that is responsible for the product and is able to ensure its quality.

x.xx**system discharge time**

for an extinguishing system of interconnected aerosol generators intended to protect the same hazard, the time from the first generator activation until the end of the last generator discharge time to achieve the design density within the protected volume

3.39**system isolate switch**

manually operated switch located at each entrance to the protected area, electrically supervised and secured from unauthorized use which prevents the automatic or manual electrical activation of the condensed aerosol generators by electrically opening the released circuit

3.40**total flooding system**

firefighting system arranged to discharge extinguishant into an enclosed space to achieve the appropriate design density

3.41**unoccupiable area**

area which cannot be occupied due to dimensional or other physical constraint requiring intentional intervention to accomplish a function

Note 1 to entry: Examples of unoccupiable areas are shallow voids or cabinets.

3.42**user**

entity whom the system is designed for, and who is responsible for operation and to ensure the consistency of performance as described by the supplier and to follow the legal regulations

4 Use and limitations

4.1 General

4.2 This International Standard sets out requirements for the design, installation, service and maintenance of aerosol systems used as fire extinguishing media for total flooding applications. This International Standard also covers performance requirements and methods of testing for aerosol generators or storage containers and associated components. The design, installation, service and maintenance of aerosol fire-extinguishing systems shall be performed by those competent in this fire extinguishing system technology. Aerosol agent description

4.2.1 Condensed aerosol

Condensed aerosol consists of finely divided solid particles typically based on alkali metal salts and gases typically comprised of nitrogen, carbon dioxide and water vapour.

Condensed aerosol is not stored in a container. It is self-generated by a combustion process of a solid aerosol-forming compound contained in a non-pressurized canister, an aerosol generator. Aerosol generators also contain an actuation device(s) designed to ignite the aerosol-forming compound and may have various cooling arrangements to cool the aerosol prior to its release into a protected volume.

The aerosol generating combustion process provides sufficient energy for a rapid discharge rate and efficient distribution of the aerosol. No stored propelling gas is required for the aerosol delivery. An aerosol generator has one or more discharge outlets and is normally placed inside the protected risk area. No piping is required.

4.2.2 Physical characteristics

Aerosols are electrically non-conductive gas-like media, which are suspended in the air in the protected volume.

Being a suspension of fine solid particles in a gaseous medium, the aerosol is not a clean agent. Following actuation of an aerosol generator there is a period of time during which the aerosol remains suspended within the enclosure; if the enclosure is not ventilated, the aerosol suspension will eventually settle down, forming a dust-like residue, normally in a very small quantity.

4.2.3 Extinguishing mechanism

Aerosols extinguish fires by:

- a) chemical interference by removing the reactive free radicals;
- b) physically cooling the seat of the fire; or
- c) reducing the concentration of oxygen by introducing inert gas.

Generally, an aerosol generator will primarily use two of the three mechanisms.

For aerosol generators that produce particulates, the chemical and cooling mechanisms take place mainly on the surface of the solid aerosol particles, and therefore, the finer the particles, the more effective the extinguishing mechanism.

For aerosol generators that produce inert gas and water vapour, these inert gases displace air, reducing the amount of oxygen available for combustion. The combustion is then cooled to the point of extinguishment as heat is transferred to the water.

4.3 Application

Aerosol extinguishants are recognized as suitable for suppression of surface type Class A fires and Class B fires.

Aerosol extinguishants have been recognized as effective media for the extinction of surface type Class A fires and Class B fires according to ISO 3941, but it should not be forgotten, in the planning of comprehensive schemes, that there can be hazards for which these mediums are not suitable, or that in certain circumstances or situations there can be dangers in their use requiring special precautions.

The hazards, against which these systems offer protection, and any limitations on their use, shall be contained in the system supplier's design manual.

Total flooding fire-extinguishing systems are used primarily for protection against hazards that are in enclosures or equipment that, in itself, includes an enclosure to contain the extinguishant. The following are examples of such hazards, but the list is not exhaustive:

- a) electrical and electronic hazards;
- b) telecommunications facilities;
- c) flammable and combustible liquids and gases.

Where aerosol generators are used in a potentially explosive application, the suitability of the generator to the atmosphere for the determined life shall be assessed. Thus, aerosol generators shall be constructed such that they do not cause fire or explosion when actuated. Aerosol generators may be used in hazardous areas subject to the manufacturer obtaining the specific listings for such areas and approvals from the appropriate authorities having jurisdiction.

CAUTION — Aerosol extinguishing systems are intended for the types of fire for which they are a suitable extinguishing medium. The end user should consider the potential adverse effects of aerosol extinguishing agent discharge residue on sensitive equipment and other objects.

4.4 Limitation of use

The extinguishants referred to in this International Standard shall not be used on fires involving the following fuels unless relevant testing has been carried out to the satisfaction of the authority:

- a) mixtures containing oxidizing materials, such as sodium chlorate or sodium nitrate;
- b) chemicals capable of undergoing autothermal decomposition, such as some organic peroxides;
- c) reactive metals (such as sodium, potassium, magnesium, titanium and zirconium), reactive hydrides, or metal amides, some of which may react violently with some aerosol extinguishants;
- d) oxidizing agents such as nitric oxides and fluorine;
- e) pyrophoric materials such as white phosphorous or metallo-organic compounds.

The above list may not be exhaustive.

4.5 Electrostatic discharge

The aerosol generating system shall be adequately bonded and earthed to minimize electrostatic discharge risk. The design and installation must comply with national and / or local electrical installation requirements / rules / standards

4.6 Potentially explosive atmosphere

Under certain conditions, the potential for explosive atmospheres may exist. Areas where such potential might exist are classified as hazardous. Aerosol generators may be used in hazardous areas subject

to the manufacturer obtaining the specific listings for such areas and approvals from the appropriate authorities having jurisdiction.

4.7 Temperature limitations

All devices shall be designed for the service they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation.

Devices shall normally be designed to function properly from $-20\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$ or a lower temperature limitation, which shall be marked on the name-plate, and in the manufacturer's instruction manual.

For condensed aerosols, special care shall be taken to determine the maximum ambient temperature at which the aerosol generator can be installed, without risk of actuation by temperature itself.

Condensed aerosol generators shall not be employed at less than the minimum thermal clearance distances specified in the manufacturer's instruction manual.

4.8 Compatibility with other extinguishants

Systems employing the simultaneous discharge of aerosols and other extinguishants to protect the same enclosed space shall not be permitted.

4.9 Environmental

When selecting an extinguishing system or agent to protect a hazard area, the effects of the agent on the environment shall be considered.

5 Safety

5.1 General

Any hazard to personnel created by the actuation and discharge of the condensed aerosol extinguishing system shall be considered in the design of the system with reference to the hazards associated with particular aerosol extinguishants. When selecting an aerosol extinguishant, careful consideration should be given to independent occupational health and safety data.

Potential hazards of aerosol extinguishing systems include noise, reduced visibility, high or low temperature, turbulence, potential toxicity, and skin or eye irritation to persons in the protected space and other areas where the aerosol may migrate. For additional information see [Annex B](#).

Determination for use of an agent in spaces that are normally occupied, normally unoccupied, or unoccupiable shall be based on an evaluation of the adverse effects(s) caused due to accidental exposure to the agent. Potential adverse health effects shall be assessed for the particulate concentration, the size of the particulates (i.e. the mass median aerodynamic diameter), and the concentration of gases expected after actuation of the aerosol extinguishing system at the concentration design density.

In any proposed use of condensed aerosol where there is a possibility that people may enter the protected enclosure or be close to the protected risk, suitable safeguards such as personnel training, warning signs, pre-discharge alarms and system isolate switches shall be provided. Means of ventilation after fire should be readily available.

Unnecessary exposure to a condensed aerosol shall be avoided.

Following the use of a condensed aerosol, personnel should not enter the protected area until it has been thoroughly ventilated. Venting of the post-fire atmosphere should be to an open-air area, where possible, to prevent the inadvertent exposure of personnel to any combustion products of the fire and aerosol-generating reaction. In case of fire involving unknown products it is imperative to check the concentration of carbon monoxide and other potentially toxic gases before entering the premises.

Following a system discharge, the aerosol that has settled should be removed in accordance with the manufacturer's recommendations. Protective clothing including gloves and goggles should be worn. A respirator or mask might be required.

Adherence to this International Standard does not remove the user's statutory responsibility to comply with the appropriate safety regulations.

In order to assess the potential human health effects manufacturers should conduct the toxicity testing for use. This requires direct toxicity assessment on the aerosol after discharge of the system at the maximum design factor.

5.2 Toxicity

5.2.1 General

No fire suppression extinguishant shall be used which is carcinogenic, mutagenic or teratogenic. Condensed aerosols

Condensed aerosol extinguishants shall be evaluated in a manner equivalent to the process used by the U.S. Environmental Protection Agency's (EPA) SNAP Program or by another international/national extinguishing agent approval institution.

Condensed aerosol extinguishing systems for normally occupied areas are permitted where the aerosol particulate concentration does not exceed the adverse effect level as determined by a scientifically accepted technique (see [Annex B](#)). Any gases produced as a result of the aerosol-forming reaction shall not exceed the appropriate excursion limit for the critical toxic effect.

When activated, condensed aerosol generators may produce toxic levels of materials, including gases, which are typical by-products of the aerosol generating reaction. Actual concentrations of these by-products depend on the chemical compositions of the solid aerosol-forming compound and coolant, engineering design of the aerosol generators and conditions of the enclosure under protection. Maximum allowable exposure to a design factor of the aerosol under conditions of a sealed enclosure shall be provided for each agent by its manufacturer. Any possible adverse effects on humans that may be experienced at the indicated allowable exposures should be described. The information shall be supported by the appropriate test results on chemical composition of the aerosol and its short-term "acute" adverse effects. The results shall be endorsed by an independent testing laboratory having an appropriate authority.

5.3 Reduced visibility

5.3.1 General

All aerosol extinguishing agents reduce visibility, depending on the applied design density. [Annex B](#) contains guidance in assessing visibility levels for aerosol extinguishing agents.

5.3.2 Safety precautions

Safety precautions such as personnel training, goggles, audio devices, floor mounted directional lighting, evacuation plans and exit drills shall be included in the operational plan for the occupancy.

5.4 Turbulence

Turbulence caused by high-velocity discharge from the condensed aerosol generator may be enough to dislodge substantial objects directly in its path, such as ceiling tiles and light fittings. Therefore, tiles and light fittings should be properly secured. Aerosol discharge may also cause enough general turbulence to move unsecured paper and light objects.

5.5 Thermal hazards

5.5.1 Minimum thermal clearance

Condensed aerosol generators shall not be employed at less than the minimum thermal clearance as specified in the listing of the product.

For locations where personnel may be situated, the minimum thermal clearance shall refer to the temperature not exceeding 75 °C.

For locations where combustible materials or equipment may be situated, the minimum thermal clearance shall refer to the temperature not exceeding 200 °C.

For locations where non-combustible materials or equ

Note 1 The minimum thermal clearance shall be applied during the time the generator is radiating heat and reach the maximum temperature after the end of discharge (not exceeding 400 °C).

5.5.2 Removal of discharged generators

Protective gloves shall be worn when removing discharged condensed aerosol generators immediately after discharge.

5.5.3 Hot work

As open flame or prolonged exposure to temperatures exceeding 200 °C may cause activation of the condensed aerosol generators, they shall be removed from a protected area prior to any hot work being carried out within their vicinity.

5.5.4 Casing temperatures for condensed aerosol generators

The manufacturer shall indicate the maximum temperature of the condensed aerosol generator casing during system discharge and the point in time to reach the maximum temperature, not exceeding 400 °C, after the end of discharge.

5.6 Safety precautions

5.6.1 General

In any proposed use of aerosol where people may enter the protected enclosure or be close to the protected risk, suitable safeguards such as personnel training, warning signs, pre-discharge alarms and system isolate switches shall be provided. Means of ventilation after fire should be readily available.

5.6.2 Specific requirements

The following general safety aspects shall apply for areas protected by the aerosol systems and which are capable of being occupied:

- a) Time delay devices:
 - 1) a pre-discharge alarm shall be incorporated with a time delay sufficient to allow evacuation of personnel prior to discharge;
 - 2) time delay devices shall be used only for evacuation of personnel or to prepare the hazard area for discharge;
- b) Exit routes, which shall be kept clear at all times, and emergency lighting and adequate direction signs to minimize travel distances for areas which may be occupied.

- c) Outward-swinging self-closing doors which can be opened from the inside, including when locked from the outside.
- d) Continuous visual and audible alarms at entrances and designated exits inside the protected area and continuous visual alarm outside the protected area which operate until the protected area has been made safe.
- e) Appropriate warning and instruction signs.
- f) Where required, pre-discharge alarms within such areas that are distinctive from all other alarm signals that will operate immediately upon detection of the fire.
- g) Means for prompt natural or forced-draft ventilation of such areas after any discharge of extinguishant. Care should be taken to completely dissipate hazardous atmospheres and not just move them to other locations.
- h) Instructions and drills for all personnel within or in the vicinity of protected areas, including maintenance or construction personnel who may be brought into the area, to ensure they take proper action when the system operates. Personnel shall not re-enter the enclosure until it has been verified as being safe to do so.

In addition to the above requirements, it is recommended that a self-contained breathing apparatus be supplied and personnel trained in its use.

5.7 Electrical hazards

Where exposed electrical conductors are present, electrical clearances no smaller than those given in [Table 1](#) shall be provided, where practicable, between the electrical conductors and all parts of the system that may be approached during maintenance. Where these clearances cannot be achieved, warning notices shall be provided and a safe system of maintenance work shall be adopted.

The system should be so arranged that all normal operations can be carried out safely by the operator.

Table 1 — Required electrical clearances to enable operation, inspection, cleaning, repairs, painting and normal maintenance work to be carried out

Maximum rated voltage (KV)	Minimum clearance from any point on or around the permanent equipment where a person may be required to stand ^a (m)	
	To the nearest unscreened live conductor in air (section clearance)	To the nearest part not at earth potential of an insulator ^b supporting a live conductor (ground clearance)
15	2,60	2,5
33	2,75	2,5
44	2,90	2,5
66	3,10	2,5
88	3,20	2,5
110	3,35	2,5
132	3,50	2,5
165	3,80	2,5
220	4,30	2,5
275	4,60	2,5

^a Measured from position of the feet.

^b The term "insulator" includes all forms of insulating supports, such as pedestal and suspension insulators, bushings, cable sealing ends and the insulating supports of certain types of circuit breaker.

5.8 Electrical earthing

Systems within electrical substations or switch rooms shall be efficiently bonded and earthed to prevent the metalwork from becoming electrically charged.

5.9 Electrostatic discharge

The system shall be adequately bonded and earthed to minimize the risk of electrostatic discharge.

6 Extinguishant

6.1 General

This clause sets out the requirements for the extinguishant concentrations. In the future, additional parts of this International Standard may be developed covering different types of extinguishing systems.

6.2 Design density requirements

6.2.1 Fire classification

For fire classifications, see ISO 3941.

6.2.2 Class B fire

The minimum Class B design density for each extinguishant shall be a demonstrated minimum extinguishing density for each Class B fuel multiplied by a safety factor of 1,3. The minimum extinguishing density used shall be that demonstrated by the minimum extinguishing density fire test ([D.6.2](#) pan fire test).

Procedures using heptane in the fire extinguishment/area coverage fire test procedure are detailed in [D.6.1](#) and [D.6.2](#). For hazards involving multiple fuels, the value for the fuel requiring the greatest design density shall be used.

6.2.2.1 Minimum Class B design density

The minimum design density for Class B fires shall be the highest (extinguishing) density derived from n-heptane pan test ([D.6.2](#)) and generator distribution tests ([D.5.1](#) and [D.5.2](#)) multiplied by a 1,3 safety factor (see [7.3.1](#)).

6.2.3 Class A solid burning surface fire

The minimum extinguishing density for Class A surface fires shall be determined by test using the fire test procedure described in [D.6.1](#) Wood Crib, [D.6.3](#) (Polymeric sheet fire tests) and [D.6.4](#) (Class A compatible wood crib test). The minimum design density for Class A surface fires shall be the highest extinguishing concentration density determined from the results of four test scenarios times a safety factor of 1,3.

6.2.3.1 Minimum Class A solid surface burning design density

The minimum design density for Class A fires solid surface burning design density shall be the highest (extinguishing) density derived from the wood crib test ([D.6.1](#)), polymeric sheet tests ([D.6.3](#)) and the Class A compatible wood crib test ([D.6.4](#)). This application would be adjusted to account for the generator distribution by multiplying by the ratio of the n-heptane pan density to the distribution test density. A safety factor of 1,3 would also be applied (see [7.3.1](#)).

6.2.4 EDP (electronic data processing) rooms, telecommunication and electronic risks

It is recognized that the wood crib and polymeric sheet Class A fire tests may not adequately indicate extinguishing concentrations suitable for the protection of certain plastic fuel hazards (e.g. electrical and electronic type hazards involving grouped power or data cables such as computer and control room under-floor voids, telecommunication facilities, etc.). An extinguishing concentration not less than that determined in accordance with [6.2.3](#), or not less than that determined from the heptane fire test described in [D.6.2](#), whichever is the greater, should be used under certain conditions. These conditions may include:

- a) cable bundles greater than 100 mm in diameter;
- b) cable trays with a fill density greater than 20 % of the tray cross-section;
- c) horizontal or vertical stacks of cable trays (closer than 250 mm);
- d) equipment energized during the extinguishment period where the collective power consumption exceeds 5 kW.

NOTE Where electrical equipment shut down is delayed, higher concentrations, longer hold times, or other fire protection systems can be considered.

6.2.4.1 Minimum EDP rooms telecommunication and electronic risks density

The minimum design density for EDP rooms telecommunication and electronic risks design density shall be the highest (extinguishing) density derived from polymeric sheet test ([D.6.3](#)) and the Class A compatible wood crib test ([D.6.4](#)). This application would be adjusted to account for the generator distribution by multiplying by the ratio of the n-heptane pan density to the distribution test density. A safety factor of 1,3 would also be applied.

6.3 Aerosol generator performance requirements

6.3.1 General

This clause sets out performance requirements for the aerosol generators.

Aerosol generators and released extinguishants shall not cause fire or explosion during actuation and discharge.

6.3.2 Distribution coverage

6.3.2.1 Condensed aerosol generators

The maximum area coverage and the maximum and minimum protected area height limitations for each condensed aerosol generator unit size shall be determined by the fire extinguishment/area coverage fire test procedure as described in [D.5.1](#) and [D.5.2](#).

6.3.3 Effective discharge

Discharge time shall be specified by the manufacturer and shall not exceed 90 s.

The minimum thermal clearances from the condensed aerosol generator's discharge outlet(s) for 75 °C, 200 °C and 400 °C shall be specified in the product listing. Refer to [7.5.2](#) for requirements on minimum thermal clearances.

Parameters of the aerosol discharge shall be verified by the test procedure as described in [Annex C](#).

6.3.4 Ambient temperature and humidity operation range

Aerosol containers shall be operable for the total service life period within temperature and humidity range specified by the manufacturer and listed by approval agencies.

The temperature operation range shall be verified by the accelerated aging test procedure as described in [Annex C](#). The humidity operation range shall be verified by the temperature and humidity operation range tests as described in [Annex C](#).

6.3.5 Service life

The service life period includes the storage and installation life period for the product. Aerosol generators shall be designed for the service they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation. The service life of aerosol generators for typical applications shall be specified by the manufacturer and listed by a listing organization.

The specified service life shall be verified by the accelerated aging test procedure as described in [Annex C](#).

6.3.6 Vibration and shock resistance

The aerosol generator and its mounting bracket shall withstand the vibration and shock resistance tests as described in [Annex C](#).

6.3.7 Corrosion

The aerosol generator and its mounting bracket shall withstand the corrosion test as described in [Annex C](#).

6.3.8 Drop Impact

The condensed aerosol generator shall comply with the function test following the effects of the drop drop impact as described in [Annex C](#).

6.3.9 Actuation element

The technical characteristics and actuation processes shall be specified by the manufacturer for all types of actuation devices incorporated in the aerosol container.

6.3.10 Exposure to fire

Aerosol containers intended for installation inside the protected enclosure shall be tested for reliability of operation and effectiveness of the discharge under the heat exposure conditions by the test procedure as described in [Annex C](#).

6.4 Marking

Manufacturers shall put a permanent name-plate or other permanent marking specifying the following on each aerosol container:

- a) extinguishant trade name;
- b) manufacturer;
- c) date of manufacture;
- d) serial number;
- e) mass of aerosol forming compound.

For condensed aerosols, installers shall attach a durable metallic tag to each aerosol generator indicating the installation date, and the expiration date. Installation life (from installation to expiration date) for condensed aerosol generators depends on the specific application and the installation environment (based on expected conditions of operation, e.g. temperature and humidity).

7 Specifications, plans and approvals

7.1 Specifications

Specifications for condensed aerosol fire extinguishing systems shall be prepared under the supervision of a person fully experienced in the design of aerosol extinguishing systems and, where appropriate, with the advice of the authority. The specifications shall include all pertinent items necessary for the proper design of the system such as the designation of the authority, variances from the standard to be permitted by the authority, design criteria, system sequence of operations, the type and extent of the acceptance testing to be performed after installation of the system, owner training requirements and working documents as defined in [A.2](#). The specification shall also include mounting parts for the generator.

Layout and system proposal documents shall be submitted for approval to the authority before installation or modification begins. The type of documentation required is specified in [Annex A](#).

7.2 Enclosure

7.2.1 Venting and structural strength

The protected enclosure shall have sufficient structural strength and integrity to contain the extinguishant discharge. Venting shall be provided to prevent excessive over- or under-pressurization of the enclosure.

A calculation method or formula to estimate a minimum vent area shall be provided by a systems manufacturer. Type and location of pressure relief vents shall ensure maximum possible containment of the agent during and after its discharge.

7.2.2 Loss of extinguishant to adjacent hazards

To prevent loss of extinguishant through openings to adjacent hazards or work areas, openings shall be permanently sealed or equipped with automatic closures. Where confinement of extinguishants is not practicable, protection shall be extended to include the adjacent connected hazards or work areas.

7.2.3 Forced-air ventilating systems

Forced-air ventilating systems shall be shut down or closed automatically where their continued operation would adversely affect the performance of the fire-extinguishing system or result in propagation of the fire. Ventilation systems necessary to ensure safety are not required to be shut down upon system activation. An extended extinguishant discharge shall be provided to maintain the design concentration for the required duration of protection. The volumes of both ventilated air and the ventilation system ductwork shall be considered as part of the total hazard volume when determining extinguishant quantities. All services within the protected enclosure (e.g. fuel and power supplies, heating appliances, paint spraying) that are likely to impair the performance of the extinguishing system shall be shut down prior to, or simultaneously with, the discharge of the extinguishant.

7.2.4 Venting requirements

When an aerosol is discharged into a closed volume, a significant overpressure may be developed due to the amount of gases generated and the effects of increased temperature on the atmosphere.